

Cargo Transfer Vehicle RCS Propellant Contamination Issues

by
Richard O. Ballard
Sverdrup Technology / MSFC Group

S2-28
NBS. ONLY
146713

ABSTRACT

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The purpose of this report is to address CTV RCS contamination issues and contribute to the resources necessary to optimize the vehicle and propulsion systems required in the Cargo Transfer Vehicle (CTV) of the National Launch System (NLS) Heavy Lift Launch Vehicle (HLLV). This study reviews the thruster-induced contaminants; their transportation from the thrust chamber to the vehicle, payload, and SSF; and the mechanism by which damage is inflicted on their components.

The effect of both monopropellant and bipropellant RCS rocket exhaust plumes on a spacecraft and related functional surfaces has been the subject of considerable study over the years. It is recognized that the RCS rocket produces contaminants which can significantly degrade the performance of optical windows, solar cells, thermal-protective coatings and other external vehicle components. This is particularly true when the rocket is operating in the pulse mode. The exhaust plume impingement pressure and heat-transfer phenomena also complicate the environment to which the vehicle and its functional surfaces are exposed, but are not addressed in this study.

Bipropellant contamination presented several modes of damage to incident surfaces, which can pose a long-term deleterious consequence to CTV payloads and the Space Station Freedom (SSF). Monopropellant contamination did not pose any significant long-term issues other than the possibility of aniline deposition. The use of either bipropellant and monopropellant propulsion systems can have a design impact on the CTV propulsion system with respect to maneuvering operations in the proximity of SSF.